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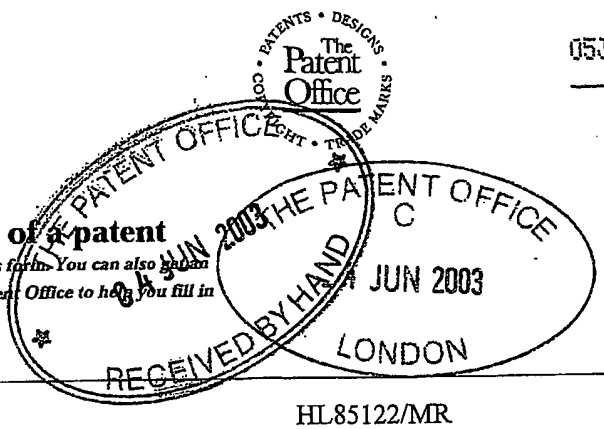

05JUN03 E812458-5 D02847
P01/7700 0.00-0312831.1

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1. Your reference — HL85122/MR

2. Patent application number *(The Patent Office will fill in this part)* — 0312831.1 — 4 JUN 2003

3. Full name, address and postcode of the or of each applicant *(underline all surnames)*

Multiclip Company Limited
Osprey House
63 Station Road
Addlestone
Surrey KT15 2AR

Patents ADP number *(if you know it)* 7789316002

If the applicant is a corporate body, give the country/state of its incorporation — United Kingdom

4. Title of the invention

NEUTRAL SECTION

5. Name of your agent *(if you have one)* — Haseltine Lake

"Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*

Imperial House
15-19 Kingsway
London
WC2B 6UD

Patents ADP number *(if you know it)* — 34001 ✓

6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and *(if you know it)* the or each application number

Country	Priority application number *(if you know it)*	Date of filing *(day / month / year)*

7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

Number of earlier application	Date of filing *(day / month / year)*

8. Is a statement of inventorship and of right to grant of a patent required in support of this request? *(Answer 'Yes' if:*

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b) there is an inventor who is not named as an applicant, or
c) any named applicant is a corporate body.
See note (d))

Yes

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Description	7
Claim(s)	2
Abstract	1
Drawing(s)	7 + 7 RM.

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Priority documents	
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Statement of inventorship and right to grant of a patent *(Patents Form 7/77)*	
Request for preliminary examination and search *(Patents Form 9/77)*	1 ✓
Request for substantive examination *(Patents Form 10/77)*	
Any other documents *(please specify)*	

11. I/We request the grant of a patent on the basis of this application.

	Signature	Date
Haseltine Lake, Agents for the Applicants	Haseltine Lake	4 June 2003

12. Name and daytime telephone number of person to contact in the United Kingdom: Meera Raval [020] 7420 0500

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NEUTRAL SECTION

The present invention relates to a neutral section for use in conjunction with railway overhead conductor lines.

Electric trains are powered through overhead copper conductor lines, the power being conveyed via a pantograph attached to the roof of the train. The conductor lines are usually powered by 25kV AC supplied from power stations along the route of the lines. As the power stations are not synchronised, a peak-to-peak difference of up to 50kV AC can occur where two power supplies meet along the length of a conductor line. It is important to ensure that the pantograph does not register the difference in power supplies as otherwise a large electrical load would be placed on it, which could damage it and other electrical equipment in the train. As it is impractical to synchronise the power stations, they are normally isolated from each other by the provision of an assembly known as a neutral section on each conductor line.

Clearly, it is important that the pantograph does not detect the presence of the neutral section on the conductor lines as, apart from electrical loading, it would also be subject to variable reaction forces, which would be conveyed to the train to cause "bumping". To avoid this, the neutral section must incorporate features that fulfil certain criteria, some of which are discussed herebelow.

Ideally, the neutral axis (median bending line) of the neutral section should be as closely aligned as possible to the neutral axis of the conductors on its either side so that the tension in the neutral section does not cause it to sag or hog under load. It is also important that the stiffness and dynamic mass of the neutral section corresponds with those of the conductors.

The neutral section should provide a continuous running surface to the pantograph that is both coplanar with the conductors on its either side (so that the pantograph is not subject to shock loading) and narrow (since misalignment with the pantograph would cause a severe twisting action in the neutral section), and that the drag imposed by the neutral section on the pantograph is equal to, or less than, that exerted on it by the conductors.

The neutral section must provide isolation over a distance in excess of 1.5m, it being necessary that this distance is maintained even when the pantograph (which is 0.2m in width) attaches to the neutral section and effectively increases its length to about 1.7m.

As the tension in conductor lines is typically provided by loads of 15kN hung every few hundred metres along their length, the neutral section must withstand these loads without degrading.

Additionally, the neutral section must perform the above functions in adverse environmental conditions such as rain, snow, contamination, etc.

The neutral sections that are currently on the market, including those provided by Siemens GmbH, Arthur Flury AG and Furrer & Frey AG, do not adequately fulfil the above criteria. For example, the neutral section of Siemens GmbH, consisting of two insulator rods mounted on plates with copper conductors being clamped thereto, is mechanically quite different from the conductors and increases the scope of shock loading on the pantograph. Although the height of the neutral section can be adjusted relative to the copper conductors in order to align them as closely as possible in the vertical plane, the catenary member that is used for such adjustment makes the neutral section assembly more bulky, increases its structural

and mechanical difference from the conductor lines, and complicates its installation. An arcing horn is provided in this neutral section to channel the power dissipation that occurs if the pantograph registers the difference in power supplies. However, it is not particularly effective in this role, as often sparks are seen to form where the pantograph attaches to the neutral section. Furthermore, this neutral section is expensive, wears quickly (it needs to be replaced roughly every eight months), and requires monthly maintenance to turn the insulator sections (which wear out by virtue of point contact with the pantograph).

Accordingly, it is desirable to provide a neutral section that effectively isolates the conductor lines without posing a "gap" to a pantograph traversing the length of the lines, is maintenance-free during the lifetime of the product, cheap to produce and simple to install.

According to an embodiment of the present invention, there is provided a neutral section for use with an overhead railway conductor line, which neutral section is disposed between the ends of the conductor line when in use and comprises an insulator to isolate the ends of the conductor line from each other; wherein the neutral axis of the neutral section is such that when the neutral section is in use the neutral axis is aligned closely with the neutral axis of the conductors on its either side and the height of the insulator is chosen so that the stiffness and the dynamic mass of the neutral section closely match those of the conductors on its either side in both the vertical and horizontal planes.

Reference will now be made, by way of example, to the accompanying drawings, in which:

Figure 1 shows a neutral section embodying the present invention;

Figure 2 shows part of a neutral section embodying the present invention;

Figure 3 is a more detailed drawing of Figure 2;

Figure 4 shows a connection member used in an embodiment of the present invention;

Figure 5 shows a neutral section embodying the present invention;

Figure 6 shows front and side views of the neutral section shown in Figure 5; and

Figure 7 shows how the PTFE rails are arranged in an embodiment of the present invention.

The structural and mechanical profile of a neutral section embodying the present invention is constructed to closely correspond with that of railway overhead copper conductor lines in order to minimise the scope of being registered by a pantograph.

Figure 1 shows a neutral section 1 embodying the present invention. The neutral section 1 includes an elongate insulator 10 moulded from an insulating material such as a glass-fibre reinforced epoxy composite with a 45% glass fraction. The outer surface of the insulator 10 can be chemically treated or coated with a paint to improve its shedding ability and be generally resilient in adverse environmental conditions.

The neutral section 1 also contains a connection member 2 by way of which it connects to adjacent conductor ends. As shown in Figures 2 and 3, in one embodiment of the present invention, the connection member 2 is a U-shaped copper member embedded within the insulator 10 with its legs 3, 4 (hereinafter referred to as conductor tails) protruding therefrom and lying adjacent to the conductors on either side of the insulator 10. One of the conductor tails 4 is connected to an end of the conductor line using conventional splices, for example, whilst the other

conductor tail 3, although usually redundant, can be used as an arcing horn if required. If there is any wear on the conductor section into which the neutral section is being fitted, the end face of the connecting conductor tail 4 can be filed accordingly so that a step height change between the neutral section and the conductor section can be avoided.

A connection member 2 used in an embodiment of the present invention is shown in more detail in Figure 4 in which Figure 4a is a perspective view, Figure 4b is a front view and Figure 4c is a side view. As can be seen most clearly from Figure 4a, pegs 5 are provided on the surface of the connection member 2, equally spaced apart and so as to protrude from the outer surfaces of the conductor tails 3, 4 at corresponding positions. The pegs 5 are driven through the surfaces of the conductor tails 3, 4, before the connection member 2 is placed in the insulator mould. When the mould sets, the pegs 5 remain firmly lodged in the insulator walls, thus ensuring that the connection member 2 is held strongly within.

In one embodiment of the present invention, the dimensions indicated in Figure 4 may be as follows: a1=30mm, a2=100mm, a3=17.09mm, a4=200mm, b1=46mm, b2=34.19mm, b3=22.37mm, c1=20mm, c2=10mm, and d=2.5mm. In addition, in such an embodiment, the radii of curvature e and f are 23mm and 11.19mm, respectively.

In an embodiment of the present invention, the profile of the neutral section 1 is matched with those of the copper conductors with which it is to be used on its either side by aligning the neutral axes of the neutral section 1 and the copper conductors. This is achieved by designing the profile of the neutral section 1 such that its neutral axis is as low as reasonably practical, such as, for example, to lie only 12mm above the neutral axis of adjacent conductors.

Furthermore, the height of the insulator is increased so that the stiffness of the neutral section 1 matches that of the conductors on its either side in both the vertical and horizontal planes.

To achieve these criteria, a neutral section 1 embodying the present invention can be designed as shown in Figure 5, in which Figure 5a is a front view of the neutral section 1, Figures 5b, 5c and 5d are cross-sections respectively taken on line A-A, line B-B, and line C-C, and Figure 5e shows an outer view of one face of the neutral section 1. As most clearly seen from Figures 5b to 5d, when in use, the profile of the neutral section 1 would be streamlined with those of the conductors lying adjacent to it.

In one embodiment of the present invention, the dimensions indicated in Figure 5 are as follows: g1=24.5mm, g2=20.71mm, g3=12mm, g4=37.6mm, g5=49mm, g6=46.52mm, g7=60mm, g8=147.59mm, g9=52.41mm, g10=47.59mm, h1=10mm, h2=19.5mm, h3=25.93mm, h4=29mm, h5=18.05mm, h6=33mm, h7=19.24mm, h8=23mm, and h9=46mm. In addition, in such an embodiment, the angle i of the sidewalls of the neutral section 1 is 12°. The radii of curvature in this embodiment are as follows: j1=5mm, j2=5mm, j3=1.5mm, j4=200mm, j5=24.5mm, j6=8mm, j7=11.19mm, j8=22.06mm, j9=8mm, j10=1.5mm, j11=1.5mm and j12=8mm.

Figure 6a and 6b show respective front and side views of an embodiment of the present invention. As can be seen from Figure 6a, two rails 6, 7 are embedded in the running surface of the neutral section 1. As these rails 6, 7 lie parallel to the conductor at each end of the neutral section 1, they provide a continuous surface against which the pantograph can run. By virtue of being made of a low friction material, such as PTFE, the rails pose less frictional drag to the pantograph compared to when it traverses the length of the

conductors, thus helping to reduce wear of the pantograph and insulator 10. As the ends of the neutral section 1 are turned up in a vertical direction, so too are the leading ends of the rails 6, 7, (as can be seen most clearly in Figure 7) which ensures that the pantograph attaches to the rails 6, 7 without hitting them. Furthermore, by virtue of being guided by the conductor tails 3, 4, onto the rails 6, 7, the pantograph attaches to the neutral section 1 in a fluid and smooth manner.

In one embodiment of the present invention, the dimensions indicated in Figure 6 are as follows: k1=1706mm, k2=200mm, k3=100mm, k4=21.6mm, k5=37.6mm, k6=49mm, l1=57.5mm, l2=18.43mm, and l3=23mm.

Although a preferred embodiment of the invention has been described, alternative implementations are possible. For example, the connection member 2 need not be U-shaped and can be any other appropriate shape. Also, the connection member 2 can be lodged within the insulator via alternative means to the pegs 5 described hereinabove. If support is required in the mid-section of a neutral section 1 embodying the present invention, the neutral section 1 may be connected to an overhead catenary system using insulation droppers attached to the spine of the section 1 via adhesive pads.

CLAIMS

1. A neutral section for use with an overhead railway conductor line, which neutral section is disposed between the ends of said conductor line when in use and comprises an insulator to isolate the ends of said conductor line from each other;

wherein the neutral axis of the neutral section is such that when the neutral section is in use the neutral axis is aligned closely with the neutral axis of the conductors on its either side and the height of said insulator is chosen so that the stiffness and the dynamic mass of the neutral section closely match those of the conductors on its either side in both the vertical and horizontal planes.

2. A neutral section as claimed in claim 1, wherein the insulator is formed from a glass-fibre reinforced epoxy composite.

3. A neutral section as claimed in claim 2, wherein the glass-fibre reinforced epoxy composite contains a 45% glass fraction.

4. A neutral section as claimed in any preceding claim, further comprising connection members for connecting the neutral section to each end of said conductor line.

5. A neutral section as claimed in claim 4, wherein each connection member is a U-shaped member with two legs, said two legs protruding outwardly from the neutral section.

6. A neutral section as claimed in claim 5, wherein one of said two legs is used for connecting the neutral section to one end of said conductor line.

7. A neutral section as claimed in claim 5 or 6, wherein the other of said two legs can serve as an arcing horn.

8. A neutral section as claimed in any one of claims 4 to 7, wherein pegs are provided on the outer surface of each connection member.

9. A neutral section as claimed in any preceding claim, further comprising a low-friction member for providing a continuous running surface between the neutral section and each end of said conductor line, said low-friction member being disposed on the underside of the neutral section and lying parallel to the ends of the conductor line when the neutral section is in use.

10. A neutral section as claimed in claim 9, wherein said low friction member is made of a low friction material.

11. A neutral section as claimed in claim 10, wherein said low friction material is PTFE.

12. A neutral section as claimed in any one of claims 9 to 11, comprising two such low friction members forming a pair of rails.

13. A neutral section as claimed in any preceding claim, wherein the leading ends of the neutral section are upturned.

14. A neutral section substantially as hereinbefore described with reference to Figures 1 to 7 of the accompanying drawings.

ABSTRACT

NEUTRAL SECTION

In a neutral section (1) for use with an overhead railway conductor line, which neutral section (1) is disposed between the ends of the conductor line when in use and comprises an insulator (10) to isolate the ends of the conductor line from each other, the neutral axis of the neutral section (1) being such that when the neutral section (1) is in use the neutral axis is aligned closely with the neutral axis of the conductors on its either side and the height of the insulator (10) is chosen so that the stiffness and the dynamic mass of the neutral section (1) closely match those of the conductors on its either side in both the vertical and horizontal planes.

[Figure 7]

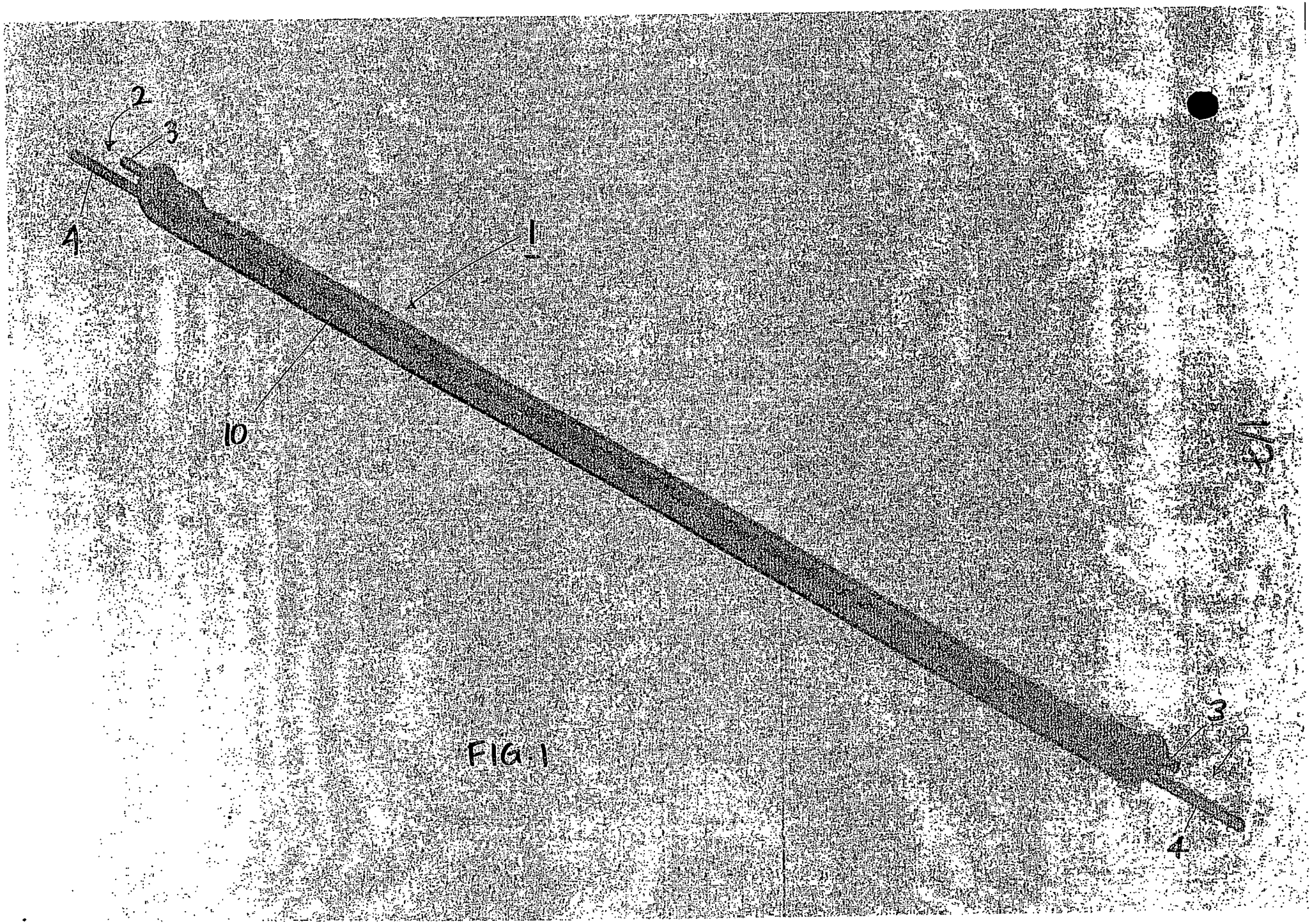


FIG. 1

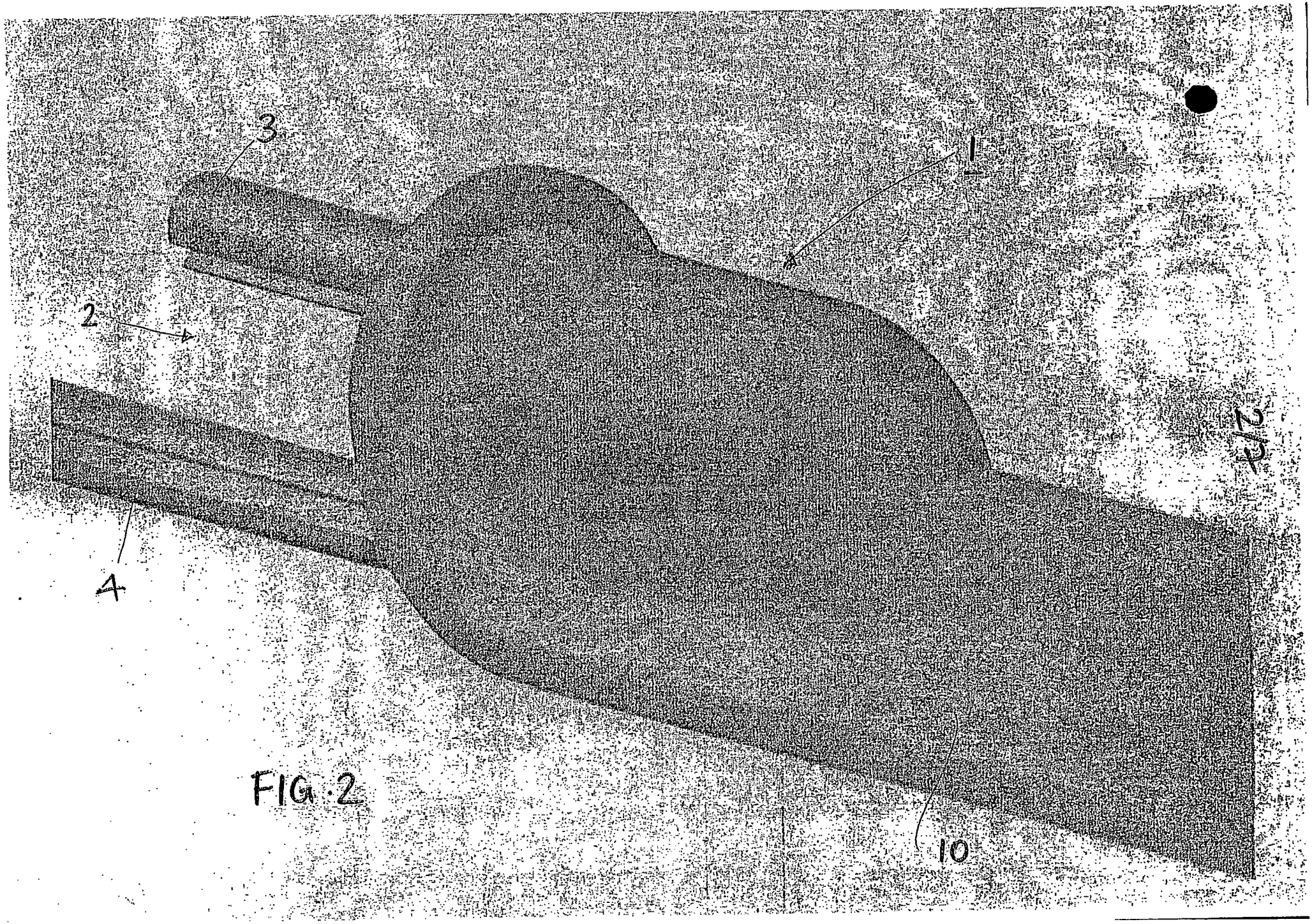


FIG. 2

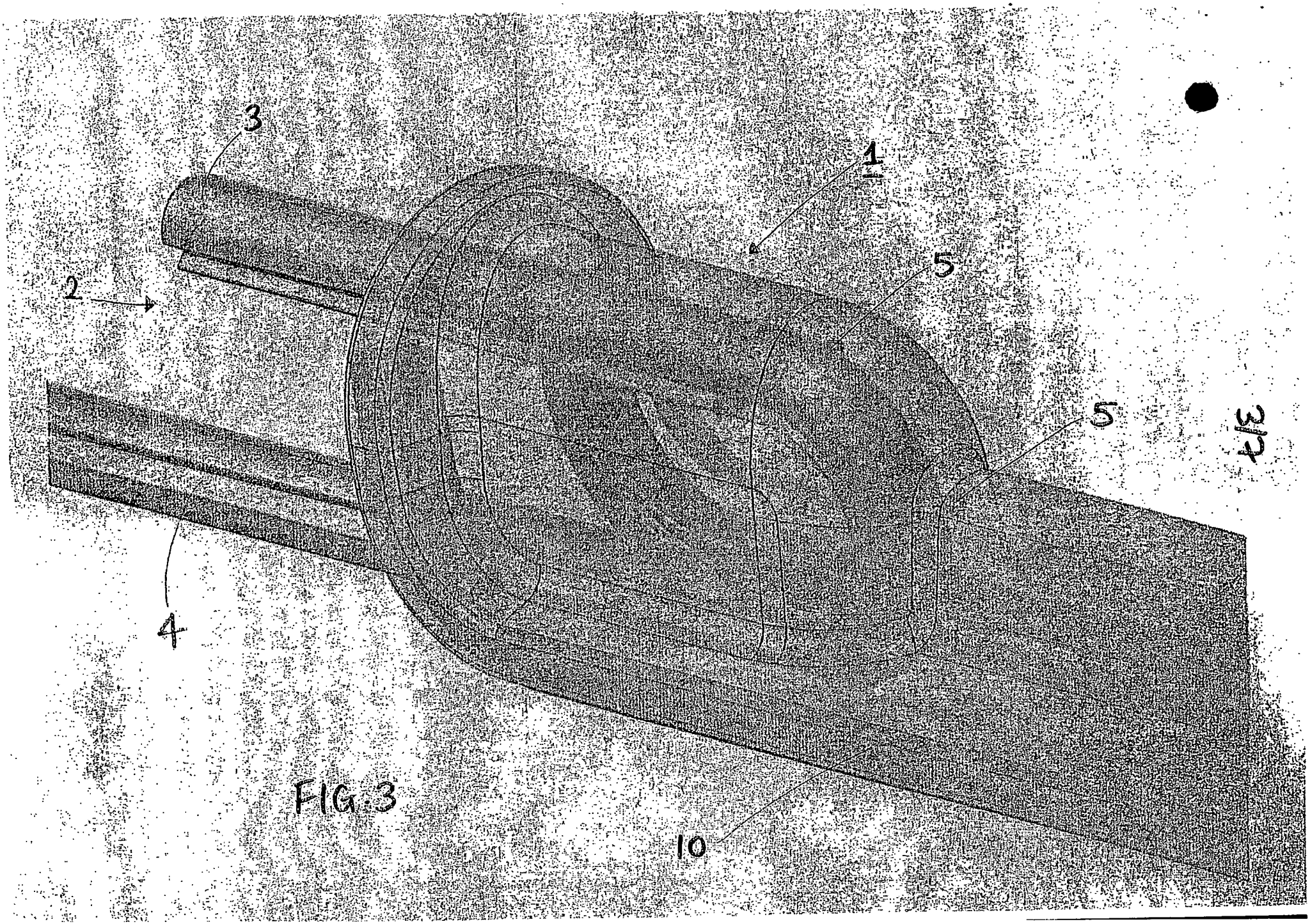


FIG.3

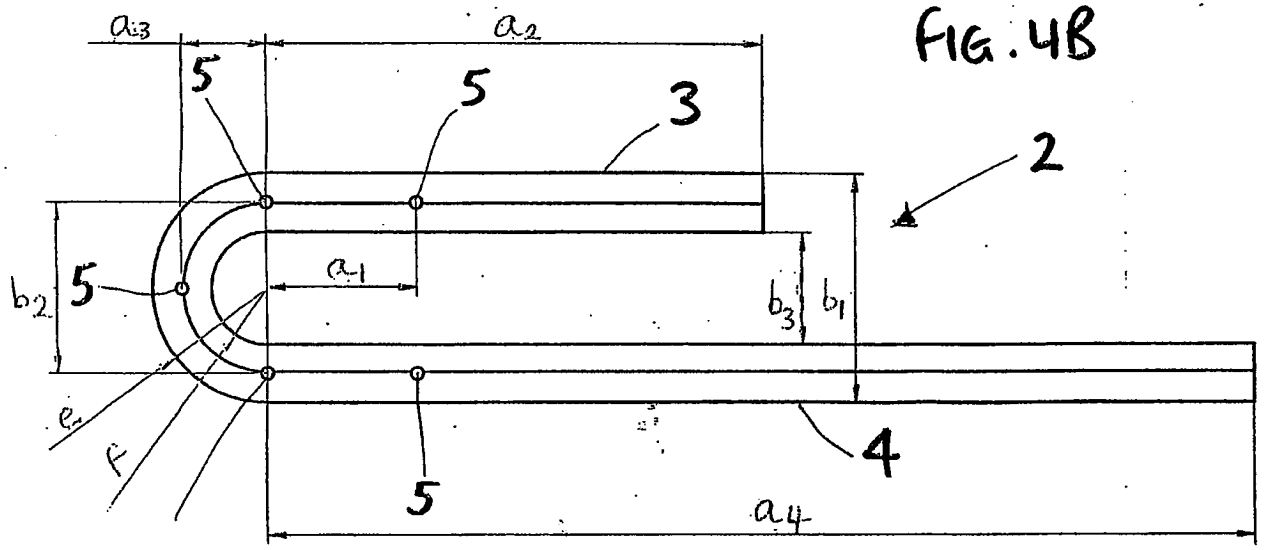


FIG. 4B

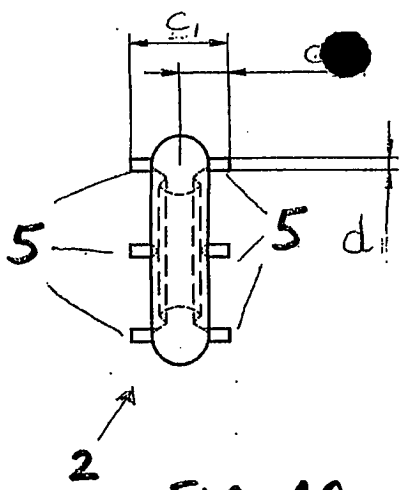


FIG. 4C

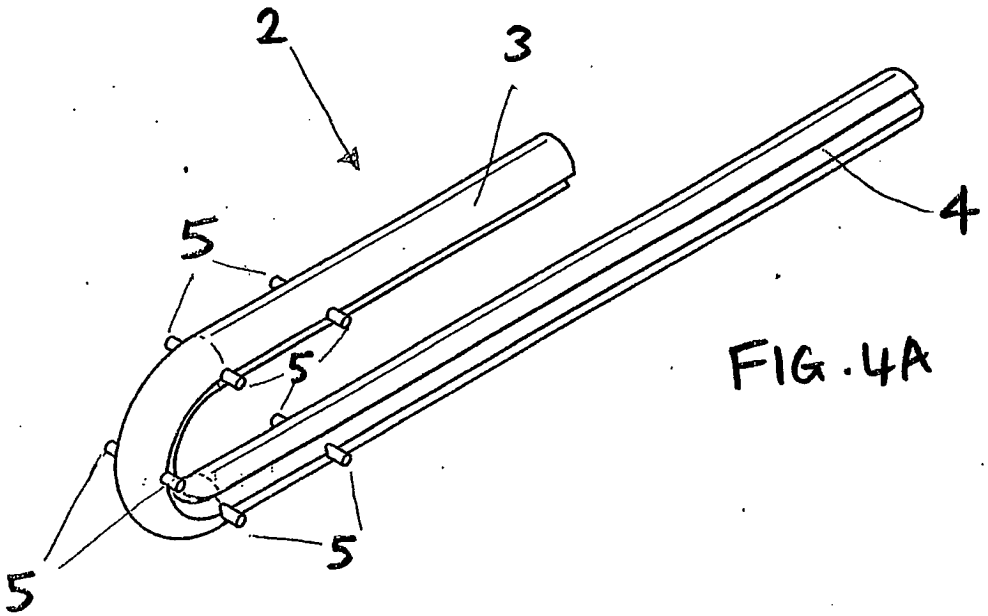


FIG. 4A

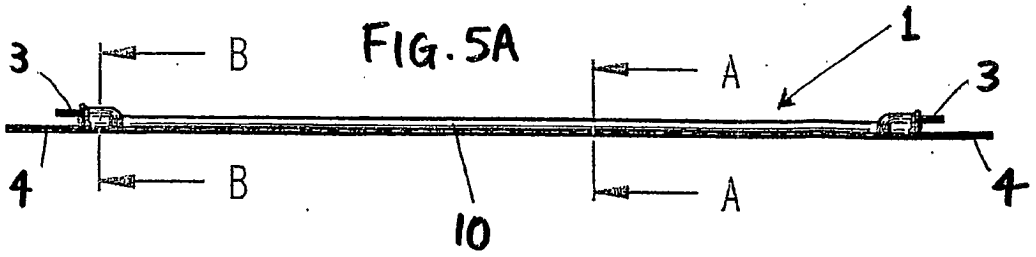


FIG. 5A

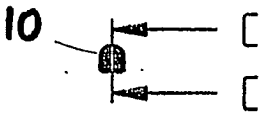
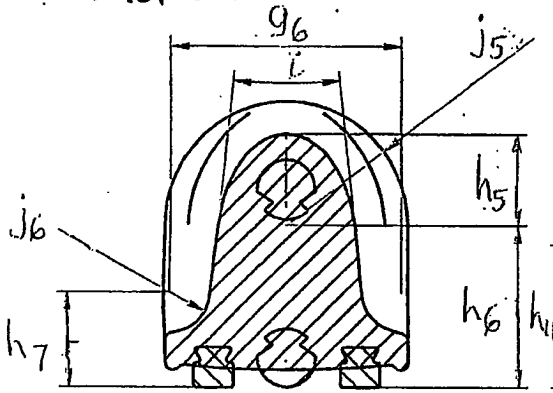


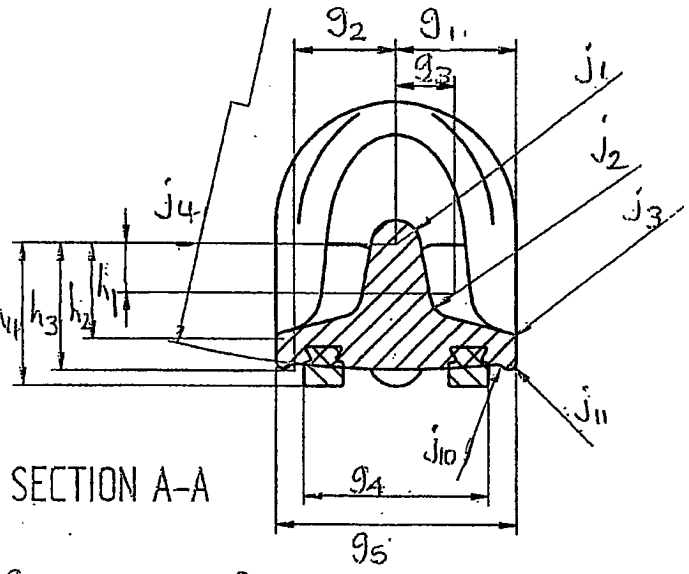
FIG. 5F

FIG. 5C

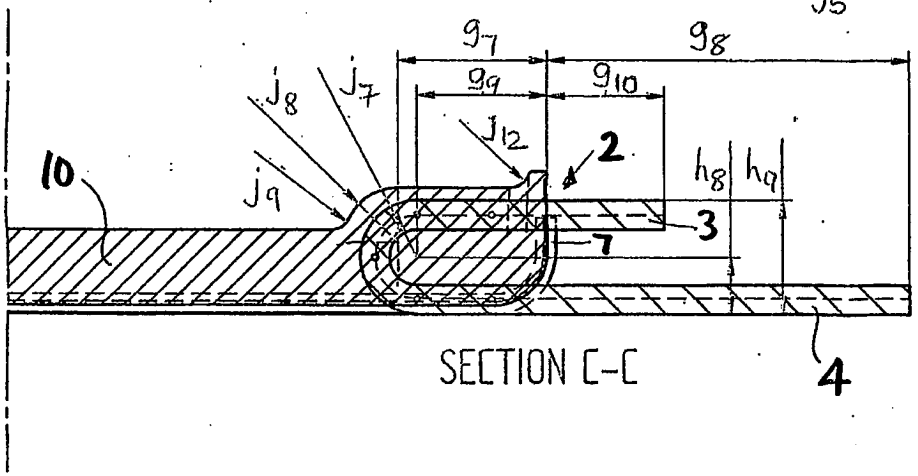


SECTION B-B

FIG. 5B



SECTION A-A



SECTION C-C

FIG. 5D

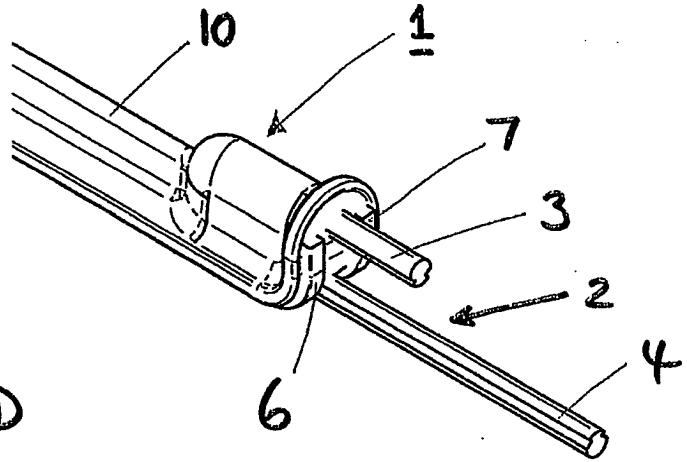


FIG. 5E

4/5

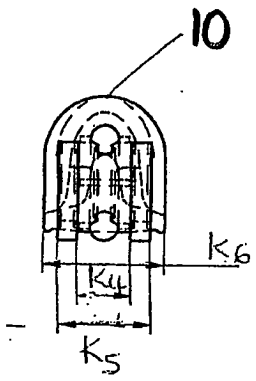


FIG. 6B

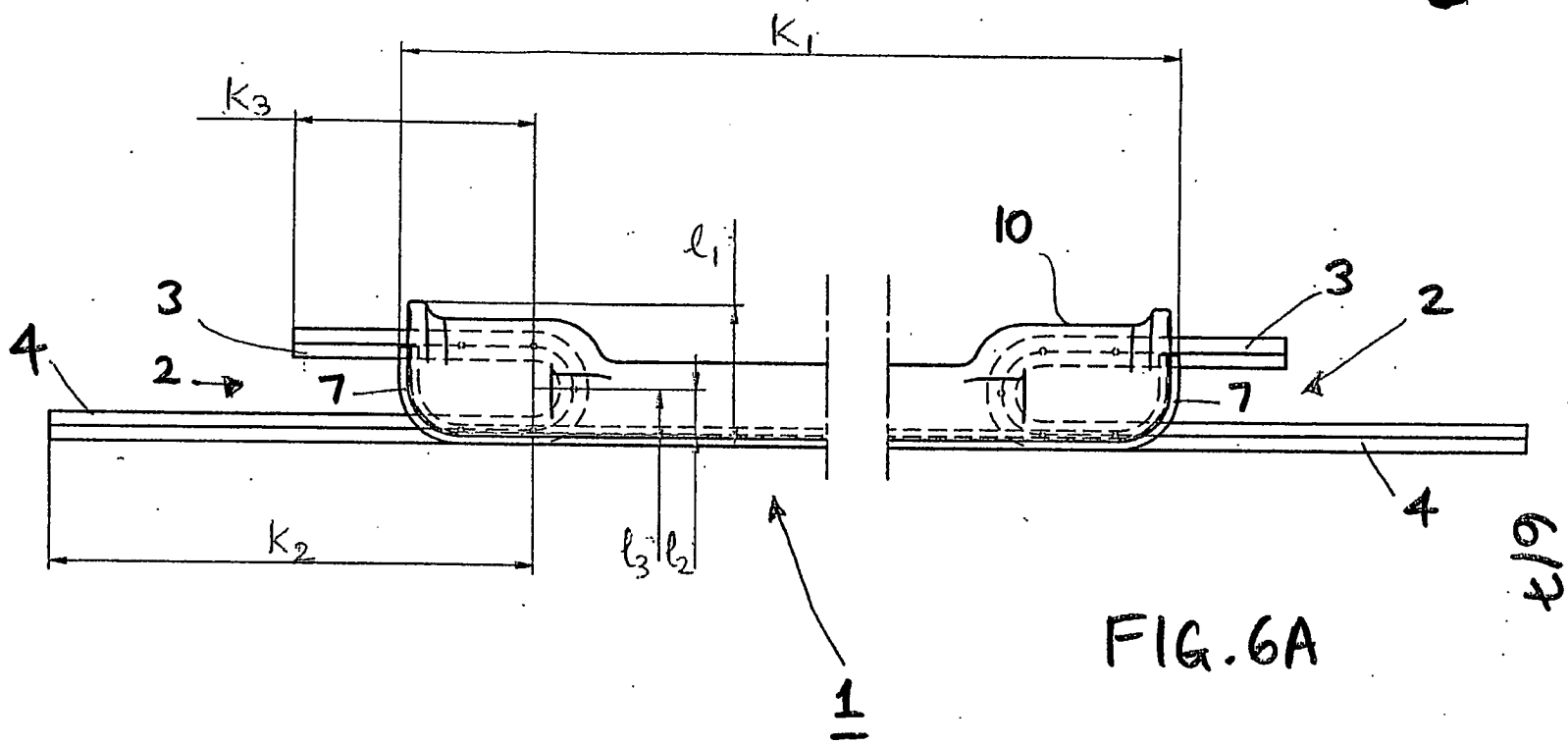


FIG. 6A

6/9

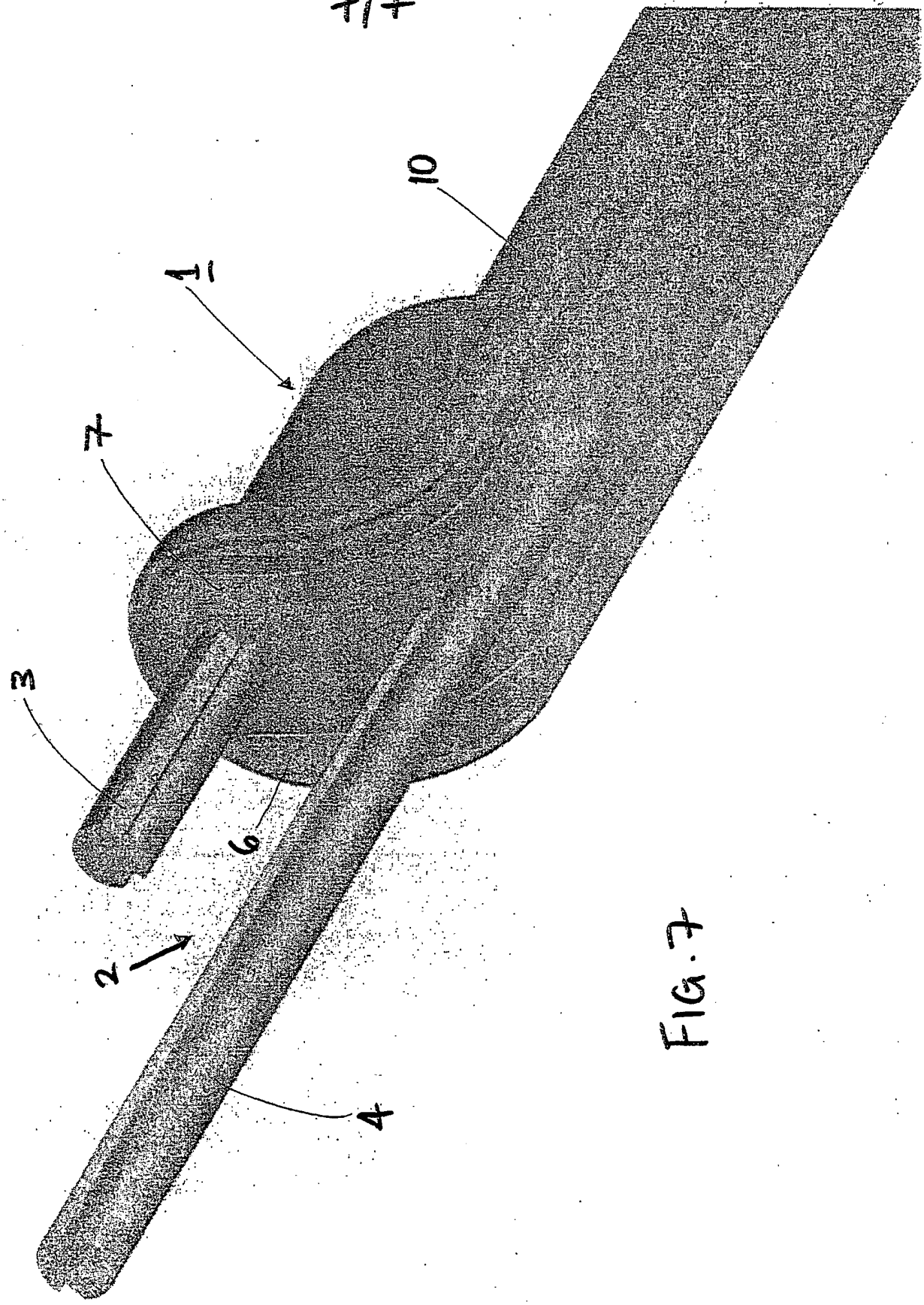


FIG. 7

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